Citation:

Spencer EA, Appleby PN, Davey GK, Key TJ. Diet and body mass index in 38000 EPIC-Oxford meat-eaters, fish-eaters, vegetarians and vegans. *Int J Obes Relat Metab Disord.* 2003 Jun; 27(6): 728-734.

PubMed ID: 12833118

Study Design:

Cross-Sectional Study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To assess differences in body mass index (BMI) among different diet groups in a European cohort and evaluate the contribution of major dietary and lifestyle factors to these differences.

Inclusion Criteria:

Participant in the Oxford cohort of the European Prospective Investigation into Cancer and Nutrition.

Exclusion Criteria:

- Participants reporting a previous diagnosis of myocardial infarction (MI), angina, stroke, high blood pressure, stroke, high cholesterol, diabetes, gallstones, polyps or cancer
- Participants with anthropometric data that were missing, measured rather than self-reported data, or height or weight that was extreme.

Description of Study Protocol:

Recruitment

Participants were part of the EPIC cohort in which 57,498 men and women were recruited between 1993 and 1999.

Design

Cross-sectional study.

Dietary Intake/Dietary Assessment Methodology

Self-reported dietary intake using a validated semi-quantitative food-frequency questionnaire (FFQ).

Statistical Analysis

- Analysis of variance was used to examine how BMI varied according to nutrient intake and non-dietary lifestyle factors
- F-tests were used to assess the statistical significance of heterogeneity in mean BMI across categories.

Data Collection Summary:

Timing of Measurements

Questionnaires were administered at baseline, between 1993 and 1999.

Dependent Variables

Body mass index was calculated from self-reported height and weight.

Independent Variables

Diet groups:

- Meat-eater
- Fish-eater (eat fish, but no meat)
- Vegetarian (eat no meat or fish)
- Vegan (eat no meat, fish, eggs, or dairy products).

Control Variables

- Smoking
- Education level
- Physical activity
- Marital status
- Ethnicity
- Parity (women)
- Energy intake
- Percent protein
- Percent fat
- Percent saturated fat
- Percent polyunsaturated fat
- Percent carbohydrate
- Fiber intake
- Percent sugars
- Alcohol intake.

Description of Actual Data Sample:

- *Initial N:* 57,498
- *Attrition (final N):* 37,875 (8,871 males and 29,004 females, after applying exclusions due to ineligibility, recording error, missing or extreme values)

- *Age:* 20 to 97 years
- *Ethnicity:* Primarily white
- *Anthropometrics:* BMI: 23.81 and 23.05kg/m^2 for males and females, respectively
- *Location:* UK.

Summary of Results:

Key Findings

- Non-dietary factors accounted for only 3% to 4% of the difference in mean BMI between meat-eaters and vegans
- Dietary factors accounted for about half the difference in mean BMI between meat-eaters and vegans
- Age-adjusted mean BMI was significantly different between the diet groups: Mean age-adjusted BMI was significantly less in both fish-eaters (23.30kg/m^2 in men, 22.66kg/m^2 in women) and vegetarians (23.37kg/m^2 in men, 22.71 in women) than meat-eaters (24.41kg/m^2 in men, 23.52kg/m^2 in women), but significantly greater than mean-age adjusted BMI in vegans (22.49kg/m^2 in men, 21.98kg/m^2 in women). The prevalence of obesity was significantly lower in vegans than other diet groups. Obesity rates were also significantly lower in vegetarians and fish-eaters than meat-eaters
- When all lifestyle and dietary factors were included in the model, the difference in mean BMI between the meat-eaters and the vegans was reduced to 0.95kg/m^2 in men and 0.68kg/m^2 in women ($P<0.01$)
- High percent protein intakes and low fiber intakes were the dietary factors most strongly associated with higher BMI between and within diet groups.

Author Conclusion:

Vegan diets, and to a lesser extent, fish-eating and vegetarian diets, are associated with lower BMI and lower levels of obesity than diets that include meat.

Reviewer Comments:

Author-identified limitations/comments:

- *Error in measuring lifestyle and dietary factors may have led to inadequate adjustment for their effects*
- *Physical activity was not ideally measured*
- *Self-report may have led to under-estimation of BMI, especially for heavier participants, which would lead to an under-estimation of the associations between dietary and lifestyle factors with BMI*
- *The estimates of nutrient intakes from the FFQ are not very accurate and adjustment for the true nutrient intakes might account for a greater proportion of the variation in mean BMI between the groups.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A

3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	N/A
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	N/A
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	N/A
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes

6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	???
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	???
7.5.	Was the measurement of effect at an appropriate level of precision?	???
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	No

8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes